Economic and Educational Impact of Firearm-Related Injury on an Urban Trauma Center

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Abstract

As nonfatal firearm-related injuries continue to increase, calculating the financial cost these injuries have on an urban trauma center may help justify funding for intervention programs. The impact these injuries have on orthopedic resident education may lead to changes in the training of some urban-based programs. This is a retrospective review of patients with an acute firearm-related injury from 2007 to 2013 at Louisiana State University Interim Public Hospital in New Orleans, Louisiana. All patients with a diagnosis of an acute gunshot wound on presentation to the emergency department were included in the study. Patients with complications from a previous gunshot wound or treatment of that wound were excluded. A total of 3617 patient encounters were identified that met this criteria. The total amount billed by the hospital over the study period was $141,995,682 while collecting $30,922,953. The actual hospital costs from these encounters was $73,572,892, giving the hospital a loss of $42,649,938. Of the 3617 patient encounters, 59% required orthopedic consultation. Of that consultation group, 25% required inpatient orthopedic surgical intervention. Acute gunshot wounds accounted for 23% of orthopedic trauma consultations and 13% of the orthopedic daily census. The financial data provide justification from an economic perspective for funding intervention programs aimed at decreasing firearm-related injury. In addition, the proportion of orthopedic surgical training spent on firearm-related injury provides program directors of urban-based programs with valuable information, although no conclusions can be drawn as to the effect on orthopedic surgical education. [Orthopedics. 2016; 39(1):e57-e61.]

After a significant decrease from 1993-2007, nonfatal firearm-related victimizations have been steadily increasing, and these events are often less sensational and thus underreported.4,5 New Orleans, Louisiana, has ranked first in murders per capita 11 times since 1985.6,7 The high concentration of gunshot violence places a large toll on the local trauma center and teaching hospital. Nonfatal gunshot injuries cost a significant amount of money to treat because these injuries require the services of a wide range of medical and surgical specialties.8

From an economic perspective, the US nonfatal gunshot incidents are estimated to cost $88 billion dollars over 5 years from hospital admissions and lost productivity, which is significantly higher.
than a similar study done in 1987 that estimated the cost to be only $4 billion annually.\textsuperscript{9,10} With health care costs expected to steadily increase over the next 10 years, an accurate depiction of the medical costs borne by gunshot violence is vital to understanding the financial impact of this preventable problem.\textsuperscript{11} The impact of gunshot violence on medical education has been rarely studied. With increasing work hour restrictions on surgical residencies, resident training must become more efficient.\textsuperscript{12} This study examines the burden on resident education from an orthopedic surgical residency perspective, identifying the percentage of consults and cases attributed to gunshot violence.

Medical research on firearm-related injuries has been muffled in the past due to the highly politicized nature of the topic.\textsuperscript{13} However, it is vital that physicians continue to engage in research on this preventable problem.\textsuperscript{14} The authors hypothesized that the financial and educational impact of firearm-related injury on an urban trauma center is significant, and the data gathered through this project will be valuable for both urban trauma centers and orthopedic educators.

**Materials and Methods**

Prior to beginning this study, institutional review board approval was granted by the Louisiana State University (LSU) Health Sciences Center of New Orleans IRB, and all patient data were stored securely and de-identified throughout the project.

Using the Spirit of Charity trauma registry database, the authors retrospectively reviewed a variety of data points for patients with a diagnosis of acute gunshot wound or shotgun blast over a 7-year period from January 1, 2007, through December 31, 2013. The authors identified 3617 patients with a diagnosis of acute gunshot wound over this period who presented in the emergency department of LSU Interim Public Hospital. The authors excluded any patient who presented to the emergency department with complications from a previous gunshot wound or complications from treatment of previous gunshot wound. Any outpatient encounters were also excluded.

The authors recorded the age, sex, race, and payer status of each patient. Age, sex, and race were offered by the patient, and where applicable in an obtunded patient, the trauma registry obtained the data via family. The presence of illegal substances on toxicology blood tests was done routinely on all trauma patients and recorded. Blood alcohol levels in excess of the Louisiana state legal limit of 0.08 mg/dL for each patient were also noted.\textsuperscript{15} The number of days the patient spent in the hospital related to this encounter was recorded, as was whether the patient survived to be discharged to home or to a step-down unit. Each patient encounter was classified and recorded as an assault, accident, suicide, or legal intervention.

The authors also determined how many patients from the 3617 encounters had an orthopedic injury, as defined by gunshot wounds to the appendicular musculoskeletal system that would require inpatient or outpatient orthopedic consultation. The appendicular system included bony injury to the clavicle or pelvis and soft tissue or bony injury distal to the clavicle or pelvis. The authors also identified how many of those with an appendicular injury required inpatient surgical intervention during that initial encounter, as well as how many patients required inpatient orthopedic surgical intervention of all patients with an acute gunshot wound.

Furthermore, the LSU orthopedic surgery residency census log was examined to determine the percentage of patients on the census list over the 7-year study period who had an acute gunshot wound as a diagnosis. All of the consultations to the emergency department for trauma are also recorded on the census log. A percentage of these consultations was calculated to determine the number of trauma consultations that were due to gunshot wounds.

Lastly, the LSU Interim Public Hospital business office provided the bills of all 3617 patients studied. The total bill amount from the initial patient encounter associated with the acute gunshot wound was recorded. The amount collected from the patient or insurer was also recorded. The authors allowed up to 1 year after the last study patient was identified to record the amount collected. Differences were calculated between amounts billed vs the amount collected.

To identify the actual cost from the hospital charges on the bill, the authors used the operating cost-to-charge ratio (OCCR) for LSU interim Public Hospital between 2007 and 2013. These data are available to the public on the Centers for Medicare & Medicaid Services website.\textsuperscript{16-22} For example, the OCCR for 2010 at the medical center in question was 0.481. One divided by this 2010 OCCR gives the answer of 2.08 or 208%. Therefore, the charges were 108% higher than cost. This calculation was done each year of the study period based on yearly OCCR data from Centers for Medicare & Medicaid Services to identify the true cost to the hospital.\textsuperscript{16-22} Once the cost to the hospital was calculated, the collections were subtracted from the costs to determine the financial net gain or loss to the hospital.

**Results**

A total of 3617 patients were identified by querying the Spirit of Charity Trauma Registry for acute gunshot wounds or shotgun blasts over the study period of 2007-2013. During the study period, the amount of patient encounters steadily increased after 2007 before sharply declining in 2013, as referenced in the Table alongside the New Orleans population and murders per year.\textsuperscript{23,24}

The patient breakdown was 89% male and 11% female, without statistically significant changes throughout the study pe-
period. Average patient age was 27.6 years, with patients ranging from younger than 1 year to 90 years. Approximately 25% of the patients were younger than 20 years. Specifically, 56 victims were 0 to 9 years, 876 were 10 to 19 years, 1519 were 20 to 29 years, 608 were 30 to 39 years, 340 were 40 to 49 years, 157 were 50 to 59 years, 37 were 60 to 69 years, and 22 were 70 years and older. The racial breakdown of victims was 82% black, 11% white, and 7% other.

Of the 3617 patients in the study, 370 (13%) had a blood-alcohol level of greater than 0.08. In addition, over the study period, 985 (27%) patients tested positive for 1 of the illegal substances routinely tested for, including marijuana, cocaine, amphetamine, or opiates. The prevalences of positive tests for the aforementioned substances were 687 for marijuana, 377 for opiates, 50 for amphetamines, 230 for cocaine, and 293 for other.

Of all gunshot wound encounters, 3304 (92%) were classified as an assault, 133 (4%) were accidental, 120 (3%) were intentionally self-inflicted, 32 (.5%) were a legal intervention, and 27 (.5%) were still under investigation.

The hospital days for all patient encounters totaled 26,267 days. Of the study population, 3110 (86%) survived to discharge. The change in the percentage of patients surviving to discharge was not statistically significant over the 7-year period. Average hospital stay was 7.26 days.

There were 2145 (59%) of 3617 patients who sustained an injury to the appendicular musculoskeletal system. These patients required inpatient or outpatient orthopedic surgery evaluation. Of the 2145 patients with gunshot wounds to the appendicular system, 25% required inpatient surgery during this encounter. When comparing the percentage of patients who needed inpatient orthopedic surgery with the number of all gunshot victims, the percentage was 15%.

Examining the LSU orthopedic surgical residency in detail, the authors identified that 13% of the daily census of the service was composed of patients with an acute gunshot wound as a diagnosis. They also found that 23% of the emergency department trauma consultations were due to injuries sustained from an acute gunshot wound.

The payer status over the study period revealed that 2403 (65%) patients had no insurance; 925 (28%) were enrolled in Medicaid or became enrolled in Medicaid by January 1, 2014; 231 (6%) had private insurance or were police officers covered under workers’ compensation; and 58 (1%) were Medicare.

The total amount billed to these patients was $141,995,682, whereas insurance and patient direct payments provided $30,922,953 in collections. This is a difference between charges and collections of $111,072,728. This translates to $20,285,097 generated in hospital bills per year while collecting approximately $4,417,564.81 per year.

Using the OCCR, the authors calculated the actual cost to the hospital for initial encounters of acute gunshot wounds to be $73,572,892 ($10,510,413 annually). However, collections totaled only $30,922,953 over the study period, which gives the hospital a 7-year net loss of $42,649,938 ($6,092,848 annually). Charges were $141,995,682.01 and the cost to the hospital was $73,572,892.23. These numbers and calculations do not take into account any subsequent treatment for the patient, including but not limited to readmission, outpatient visits or procedures, or inpatient or outpatient therapy.

**DISCUSSION**

Gun violence in major US cities is an undeniable problem. Post-Katrina New Orleans is no exception, with statistics showing a murder per capita rate in 2008 higher than that of Baghdad, Iraq. Although calculating the human toll of this problem may be impossible, the authors are able to calculate the financial impact of gun violence.

With a payer mix of 65% of patients with firearm-related injury having no insurance and 28% having Medicaid, the collected payments from acute gunshot injury encounters was relatively low, showing a difference between what was billed and collected of approximately -$111,000,000 over 7 years.

Taking into account the published OCCR ratio over the study period, the actual net loss borne by the hospital was approximately $42 million ($6 million annually). However, this loss is likely an understatement of the total medical losses from firearm-related injury because these numbers do not account for further treatment, such as therapy and outpatient procedures.

Not only is the operating financial loss of the hospital an economic burden for local taxpayers, but also the collections the hospital did receive were mostly from state taxpayer programs, such as

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**Table**

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<th>Item</th>
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<th>2010</th>
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Medicaid and federal taxpayer funded Medicare. Therefore, the economic burden is understated by just the losses of the local trauma center, and any investment into the prevention of these occurrences would not only be beneficial from a humanitarian perspective, but it may also tremendously lessen the financial burden on the state and federal taxpayer.

The second aim of this study was to identify the impact firearm-related injuries have on resident education at urban trauma centers. Treating gunshot violence requires a multi-specialty approach, and all medical specialties are directly involved. With the decreasing work hour restrictions for medical and surgical residents, an increasing percentage of a resident’s workload is spent treating these patients.

A study published in 1997 by Brown et al during the height of gun violence in New Orleans showed that gunshot wound injuries required more orthopedic trauma resources than any other single diagnosis. Twenty years later, similar results to Brown et al are demonstrated with the orthopedic service being consulted on 59% of all of the acute gunshot encounters, and 25% of those consults undergoing orthopedic surgical intervention.

The difference now is limited work hours mandated by the ACGME not present 20 years ago. Orthopedic resources are becoming stretched thin, and the ability to offer orthopedic trauma care to all patients under these work hour restrictions will become difficult. Orthopedic surgical training may be compromised as well by devoting a larger percentage of work hours to one specific facet of the specialty. Despite the inordinate amount of time and effort spent on this one diagnosis, it is not listed as on the ACGME Milestone project as one of the elements an accredited orthopedic surgery residency needs to develop competency in the field. Urban-based orthopedic residency programs can use this information in structuring their residency programs.

These limitations in resources caused by high levels of firearm-related injuries also strain the ability of the orthopedic surgical service to treat the orthopedic needs of the indigent population. To accommodate the surgical cases due to gunshot violence, elective and subacute orthopedic cases that serve the needs of the indigent population are routinely cancelled.

In completing the 2 main goals, the authors found an increase of firearm-related injury up to the last study year, which was then followed by a sharp decline in the last study year (2013). This echoes findings by the Department of Justice showing a gradual increase in nonfatal firearm-related victimizations in the United States from 2007 to 2011.

However, despite the city population increase in 2013 from 369,888 to 378,715, there was still a decrease in the absolute number of incidents, which may be related to the initiation of Operation Ceasefire at the hospital during that time or local leadership changes. Further studies to delineate the impact Operation Ceasefire has played in the decline of acute gunshot incidents are still in progress, but 1 recent study reports that a similar program, Operation PeaceWorks, is showing promise in decreasing the incidence of penetrating trauma.

The 2010 census showed the breakdown of race in New Orleans to be 60% black, 33% white, and 7% other; however, the current results of gunshot victims illustrate a disproportionate amount of black victims, at 82%. This is not unique to the current population as nationally victims are 6 times more likely to be black and 14 times more likely to be men.

Results of routine toxicology tests can be interpreted different ways. Victims may be more at risk if under the influence of alcohol or drugs and make for easy targets, or perhaps the distribution or use of drugs and alcohol placed them in a precarious situation. Regardless, there is a clear link echoed by studies on the victims of firearm-related injury to the use and abuse of alcohol and illegal substances.

The majority of firearm-related injuries were due to assault, at 92%. Assault is a preventable problem that could be drastically reduced with a variety of interventional tactics. Although accidents (4%) may be inevitable, assaults are preventable, and suicides (3%) may be lessened with better mental health care.

**Conclusion**

Whether firearm-related injury is called a “disease” or just a problem, the current research demonstrates the economic impact to one urban trauma center. Further research into this problem and interventional programs may help alleviate the burden firearm-related injuries place on taxpayers.

**References**


